

POWERSTROKE DRILLING JAR

Instruction Manual 4250



PowerStroke Hydraulic Double-Acting Drilling Jar



NATIONAL OILWELL VARCO

One Company Unlimited Solutions

PowerStroke Drilling Jar

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Warning and Safety Summary

Safety Precautions

Safety was a high priority when the PowerStroke Drilling Jar was designed. Safety must also be a high priority while performing routine maintenance and testing on the tool. The following general precautions should be observed when operating or performing maintenance on the PowerStroke Drilling Jar.

NOTE: Nothing in this section or in this manual supersedes or replaces standard, normal, or common safety practices and procedures.

- a. Only qualified personnel should perform maintenance or operate the PowerStroke Hydraulic Drilling Jar.
- b. When in doubt about proper assembly procedures, configuration, and/or operation of the PowerStroke Drilling Jar, please refer to the appropriate section in this manual.
- c. Wear safety glasses at all times when performing maintenance or testing on the Jar.
- d. Always use the correct tools when performing maintenance on the Jar.
- e. Keep the assembly and testing area as clean and organized as possible.

Warnings, Cautions, and Notes — Definitions

The terms WARNING, CAUTION, and NOTE are used in the procedures in this manual and should be read and observed. The terms are defined in the following paragraphs:

WARNINGS are set aside from the text and contain essential information about potentially dangerous conditions, operations, or procedures. **WARNING** messages are concerned with personnel injury and are printed in capital letters and boldface type.

WARNING: DO NOT REMOVE FILL PLUGS (29 AND 50) OR WASHPIPE BODY (64) FIRST. INTERNAL RESIDUAL WELL PRESSURE MAY EXIST WITHIN THE JAR AND CAN CAUSE SERIOUS INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

CAUTIONS are set aside from the text and contain essential information about potentially hazardous conditions, operations or procedures. A **CAUTION** calls attention to actions and situations that could cause damage to equipment.

CAUTION: Support the Drilling Jar Bodies being removed with a belt pulley system to prevent galling of the threads from the unsupported weight of the Drilling Jar.

NOTES contain useful information related to conditions, procedures or equipment and provide assistance in operating, maintaining, or repairing the components and assemblies. They are also used to clarify portions of the text.

NOTE: Outside Body wear due to rotary cycles is acceptable as long as it is within the acceptable tolerances as noted by the manufacturer. If you are in doubt about any part, it probably should be replaced.

1.0 Introduction

This manual contains information and instructions pertaining to the operation and preventive maintenance of National Oilwell's new **PowerStroke Hydraulic Double-Acting Drilling Jar**. If properly operated and maintained, this Jar is dependable and will provide long lasting service. Therefore, it is important that all operating and maintenance personnel carefully review and study all sections of this manual that pertain to any operation and maintenance tasks they may need to perform.

1.1 Scope

The scope of material included in this manual is limited to operation and recommended maintenance procedures considered to be routine or frequent operations. This manual is not intended as a textbook on mechanics, hydraulics, or drilling. Sufficient descriptive material and illustrations are included to enable the operator to understand the basic construction, theory of operation, and maintenance of the PowerStroke Drilling Jar. The primary objective and intent of this manual is to guide operators and maintenance personnel in the proper operation, maintenance and use of the Jar.

2.0 General Description

The new National Oilwell **PowerStroke Hydraulic Double-Acting Drilling Jar** is a one-piece variable trip load Jar that can provide upward and downward jarring blows for freeing stuck drill strings (See Figure 2.1). This Drilling Jar will jar up or down with any load that is applied to it, up to the maximum rating for the tool.

It has an extra long stroke to allow the operator to deliver exceptional impact and impulse forces during jarring operations. Internal impact surfaces were designed into the tool to keep well cuttings from diminishing the Jar's impacts.

Both the Up Jarring Section and the Down Jarring Section are hydraulically operated. The Up Jarring Section is capable of striking upward blows of infinitely variable intensity, up to the maximum rating of the tool, by simply changing the upward pull of the drawworks. The Down Jarring Section works the same way, but is limited by the available string weight available to deliver the downward blow. The impact load developed by the jarring mechanism is generally several times greater than the load that has been applied to the Jar. The high impact load is delivered to the stuck point in the string below the Jar.

Under normal conditions these Jars will operate in downhole temperatures to 250° F. with standard packing, but by maintaining proper circulation they can operate in formation temperatures up to 400° F. High temperature packing is available which allows the Jars to operate in formation temperatures up to 600° F. The Jars are fully balanced for hydrostatic pressure and can be used at any depth.

2.1 PowerStroke Drilling Jar Features

All Jars come fitted with National Oilwell designed flex subs, allowing for elevator lift areas that have been incorporated into the design (See Figure 2.1).

All Jars are approximately 30 – 31 feet long, allowing for easy racking when pulled from the drill string.

All Jars are equipped with Safety Collars to prevent accidental firing while racked.

All PowerStroke Drilling Jars can be easily adapted to any drill string by simply changing the top flex sub and the bottom sub to accommodate different connections as required.

Simple up and down motion is required to fire the Jars.

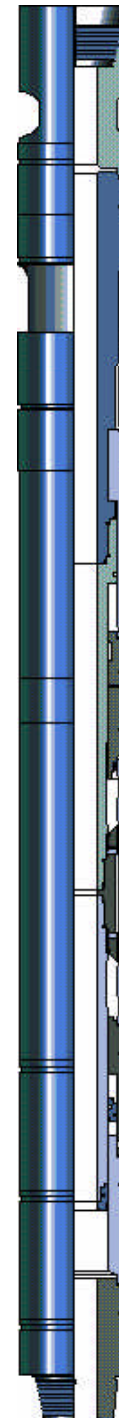


Figure 2.1
PowerStroke Hydraulic Double-Acting
Drilling Jar Assembly

All PowerStroke Drilling Jars utilize a sealed and lubricated spline drive for long life in harsh environments.

No minimum load is required to fire the Jar. Except when the Jar is equipped with the Down Stroke Lockout Device.

Note: The Down Stroke Lockout Device is still under development and testing at this time. Contact your National Oilwell representative for more information.

All Jars incorporate the National Oilwell patented cone type piston assembly (self-cleaning, metering design).

All PowerStroke Drilling Jars are manufactured to ISO-9000 specifications.

2.2 Explanation of Mechanism

The hydraulics of the PowerStroke Hydraulic Double-Acting Drilling Jar are built around the proven design of the cone-type piston (see Figure 2.2). There are three primary parts to the Cone Assembly: Cone, Seal Body and By-Pass Body.

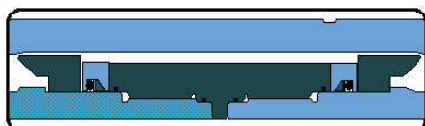


Figure 2.2
Drilling Jar Up and Down Mechanism

The Washpipe Connector and a machined shoulder on the Mandrel Extension hold the Cone and Seal Body in place for the Up Jarring Section. The Cone and Seal Body are free floating. When the Jar is pulled and the Cone moves into a restriction in the Pressure Body, the Cone and Seal Body are pressed together forming a seal between the two ground surfaces. Oil then passes through precision metering grooves in the bottom of the Cone. As the Mandrel is extended in the upward direction, it is restricted by the slow flow of oil through the metering grooves on the Cone. Oil

continues to slowly meter until the Cone reaches an undercut relief area in the Pressure Body, at which time the oil can by-pass around the outside of the Cone. This allows the energy stored in the drill string to snap upward, like a rubber band, pulling the Mandrel and Mandrel Extension up at a very high rate of speed until the top face of the Mandrel Extension strikes the impact shoulder in the Spline Body. This sudden impact produces the upward jarring blow.

The Cone, By-Pass Body, and Seal Body for the Down Jarring Section, are held in place by a shoulder on the Washpipe and the Washpipe Connector. The operation is identical to the Up Jarring Section except the movement is created by the drill string weight that is set down on the Jar.

3.0 Operation

The PowerStroke Hydraulic Double-Acting Drilling Jar will arrive at the rig ready to be installed in the drill string. The Drilling Jar is shipped in the open position with the Safety Collar installed. The Safety Collar is clamped over the exposed area of the Mandrel and should not be removed until the Jar is made up in the drill string. The Safety Collar should be reinstalled on the Mandrel when the Jar has been tripped back to the surface and before it is removed from the drill string.

WARNING: THE DRILLING JAR WILL FIRE DOWN UNEXPECTEDLY IN THE RACK IF THE SAFETY COLLAR IS NOT INSTALLED. THIS CAN CAUSE SERIOUS INJURY TO PROPERTY AND PERSONNEL.

3.1 Running the Tool in the Drill String

As with all Drilling Jars, the PowerStroke Drilling Jar should be placed above or below the weight on bit range "neutral point," with a safety factor. This will insure that the tool is in tension or in compression while run in the drill string, reducing cyclic bending stresses that

may cause potential fatigue problems with the Drilling Jar's internal connections. It is also recommended that the tool not be run directly on top of a stabilizer, between different size drill collars, or between drill collars and heavyweight drill pipe. This keeps the tool away from the transitional bending points in Bottom Hole Assemblies (BHAs), an area of the drill string that has cyclic bending stresses that can cause fatigue problems.

You can contact your nearest National Oilwell, Downhole Tools representative and he can run the Jar Placement Program for you. You may also request a copy for your own use. This program will not only help to insure that you do not run the tool in a location of the string that may cause potential problems, it will maximize the efficiency of the Drilling Jar to provide the greatest impact and impulse values.

CAUTION: The rig floor tongs should only be placed on the Flex Sub and Bottom Sub when making up the Drilling Jar to the drill string. TONGING ON OTHER OUTER BODIES OF THE DRILLING JAR MAY RESULT IN OVER TORQUING A BODY CONNECTION OR INADVERTENTLY BREAKING A CONNECTION.

NOTE: The Jar Placement Program should be used to optimize the location of the Jar in the drill string which will maximize the impact and/or impulse load delivered by the Jar.

Having selected the most desirable location for the Jar in the drill string using the Jar Placement Program, lift the PowerStroke Drilling Jar, utilizing the elevator recess on the flex joint at the top end of the tool, and place it in the drill string. Make sure to torque the Jar's API tool joints properly. Remove the Safety Collar and you are ready to trip the tool into the well.

CAUTION: Do not handle the tool in any way, which would make the tool close. This will cause the up jar mechanism to cock. If it should fire while going into or out of the well, it may damage the rig or cause the slips to fail.

The operator should also be aware that any downward “spudding” through a tight area of the well might place the Jar in a cocked position. If such an occurrence is suspected, the slips should be set, the elevators left in place on the pipe, and inhole operation suspended for approximately 10 minutes. If the Jar was cocked, this will allow the weight of the collars below the Jar to pull it into an open position. A moderate jarring blow may be noticed when this occurs.

The Jar may be run in tension or compression.

3.2 Tension Drilling

The PowerStroke Drilling Jar will normally remain in an open position (Mandrel extended) while drilling or tripping. The weight of the collars below the Jar plus the pump open effect of the mud pressure against the Washpipe area tends to keep it open. When operating, loads must remain within the maximum ratings for the tool. (See strength data on page 19).

3.2 Compression Drilling

CAUTION: Since the Jar will cock to the neutral position whenever the string is picked up off the bottom, this procedure should be followed each time a connection is made.

The PowerStroke Drilling Jar may be run in compression. The Drilling Jar will normally be in tension when the bit reaches bottom and should be triggered down with a light load in order to avoid any chance of damage to the bit. The recommended procedure is to begin rotating, slack off enough weight so that the Jar is only slightly in compression (5,000 lbs. to 15,000 lbs.), and after the Jar falls through, slack off to the final drilling weight on bit.

3.4 Jarring Operations of the PowerStroke Drilling Jar

The Jar will be run in the hole in the fully open position. To begin jarring operations, slack off enough weight to the Jar to overcome hole drag and the pump opening effect. The operator of the Jar should be able to spot the free travel of the Jar once the hole drag and the pump opening effect are overcome. Continue to slack off until the weight indicator shows that the free travel has stopped and more weight is coming off the weight indicator, approximately 12 to 15 inches of stroke. When the operator sees this, he can then jar either up or down by simply picking back up on the drill string or slacking weight off of the drill string. If the desire is to jar down, slack weight off of the weight indicator until the desired jarring load is reached, set the brake and wait for the Jar to trip. Once the drilling Jar trips, pick up on the drill string and watch for the free travel of the Jar as it is re-cocked, again approximately 12 to 15 inches. When the weight indicator shows that the operator is beginning to apply over-pull to the Jar, he can then continue to apply over-pull to the drill string to jar up or he can slack back off of the drill string to the desired down jar load and jar back down. If the desire is to jar up, pick up on the string until the desired jarring load is reached, set the brake and wait for the Jar to trip. The time required to fire the Jar is dependent on the load applied. Typically 20 to 60 seconds depending on the load applied.

There are many factors that affect the load delivered to the Jar. The most significant factors are friction drag, weight indicator error, and “pump open” effect if circulating while jarring. Usually in “straight” holes the friction drag is minor, but it can be significant in “crooked” holes. The operators must rely on their experience and knowledge to compensate for friction drag. The PowerStroke

Drilling Jar may be run in compression. The Drilling Jar will normally be in tension when the bit reaches bottom and should be triggered down with a light load in order to avoid any chance of damage to the bit. The recommended procedure is to begin rotating, slack off enough weight so that the Jar is only slightly in compression (5,000 lbs. to 15,000 lbs.), and after the Jar falls through, slack off to the final drilling weight on bit.

3.4.1 Jarring Up

If the string becomes stuck and upward jarring is needed, proceed as follows:

Lower the string until slightly more weight than the operator feels is necessary to overcome the string friction in the hole shows on the weight indicator. A very minimal slack off is needed to cock the Jar.

Raise the string to trip the Jar. The jarring force is infinitely variable depending on the drawworks speed and load applied. Some operators start with moderate forces and increase each time until the string breaks loose. See Section 15.0 for Drilling Jar Specifications on page 19. Do not pull forces more than the string weight above the Jar plus the maximum up jar trip load.

If the first pull fails to trip the Jar, the slack off may not have been enough to cock it. Lower the string again and slack off further on the weight indicator and repeat the above process.

3.4.2 Jarring Down

When jarring down becomes necessary, proceed as follows:

The PowerStroke Drilling Jar is normally run in the extended or open position during a normal drilling operation. If jarring down becomes necessary, the Jar will already be cocked and ready to fire. Lowering the string weight will cause the Jar to fire, providing an impact to the

stuck point in the drill string in the down direction. The force applied at the stuck point is dependent on the amount of weight that is lowered onto the Jar at the time of use. If a Down Stroke Lockout Device is provided in the assembly, the procedure may vary slightly. See Figure 5.1 PowerStroke Pump Open Force Chart on page 8.

Note: The Down Stroke Lockout Device is still under development and testing at this time. Contact your National Oilwell representative for more information.

CAUTION: When a down load is applied to the Jar, the Up jar section automatically cocks. Therefore, do not pull too long when cocking the Down jar section because the Jar may fire up causing adverse effects to the jarring operation.

NOTE: The load can be seen on the weight indicator as the Up jar section of the Drilling Jar starts to enter the restricted up jarring chamber of the Pressure Body.

To reset the Down jar section of the Drilling Jar, raise the string until a load slightly greater than the string weight above the Jar is indicated.

3.5 Horizontal Drilling Operations

For horizontal drilling, National Oilwell is in the development and testing phase of a new Down Stroke Lockout Device for the PowerStroke Drilling Jar. Its purpose will be to prevent the tool from stroking when cycled between tension and compression, which is common in long reach horizontal wells. The lock will keep the tool in one position until a predetermined load is exceeded which will all but eliminate the possibility of unexpectedly firing on the bit. It will also eliminate the time that is lost to cycle through the Jar's timing sections each time that the bit is picked up off bottom.

4.0 Load Calculations

It is common practice to calculate the weight of the string above a Drilling Jar, add the desired jarring pull to the string weight, and assume that the correct jarring pull has been established. In fact, there are several other factors that affect the load that is actually delivered to the Jar and make it appear to trip at a different load than indicated at the surface. The most significant factors are friction drag, weight indicator error, and "pump open" effect if circulating while jarring.

Friction drag is usually minor in straight holes, but in deviated holes the increase in friction drag when stuck can be substantial and must be considered when calculating pull loads for jarring. The additional tensile load placed in the string by jarring pulls will cause the string to bear heavily against doglegs in the hole, with a resulting increase in friction. The following examples illustrate the results of increased friction when tripping the Jar upward.

4.1 Straight Hole Conditions

$$\begin{aligned} \text{Weight above Jars} &= \\ 262,000 \text{ lbs. (weight indicator reading)} &- 18,500 \text{ lbs. (weight below Jars)} \\ &= 243,500 \text{ lbs.} \end{aligned}$$

$$\begin{aligned} \text{Pull to trip the Jar} &= \\ \text{weight above Jar} &+ \text{desired jarring load} + \text{weight indicator error} + \text{increased friction} \\ &= 243,500 \text{ lbs.} + 120,000 \text{ lbs.} + 6,000 \text{ lbs.} + 5,000 \text{ lbs.} \\ &= 374,500 \text{ lbs.} \end{aligned}$$

4.2 Crooked Hole Conditions

$$\begin{aligned} \text{Weight above Jar} &= \\ 262,000 \text{ lbs. (weight indicator reading)} &- 18,500 \text{ lbs. (weight below Jars)} - 30,000 \text{ lbs.} \end{aligned}$$

$$\begin{aligned} \text{Pull to trip Jar} &= \\ \text{Weight above Jars} &+ \text{desired jarring load} + \text{weight indicator error} + \text{increased friction} \\ &+ 213,500 \text{ lbs.} + 120,000 \text{ lbs.} + 6,000 \text{ lbs.} + 45,000 \text{ lbs.} \\ &= 384,500 \text{ lbs.} \end{aligned}$$

The foregoing examples illustrate the difference in pull load under different downhole conditions even though the desired jarring load and string weight indicator readings remained the same. The friction factor and weight indicator readings were assumed and obviously will vary widely. The operator must rely on his experience and knowledge of downhole conditions to choose appropriate factors. Down Jar operations are affected in a similar manner.

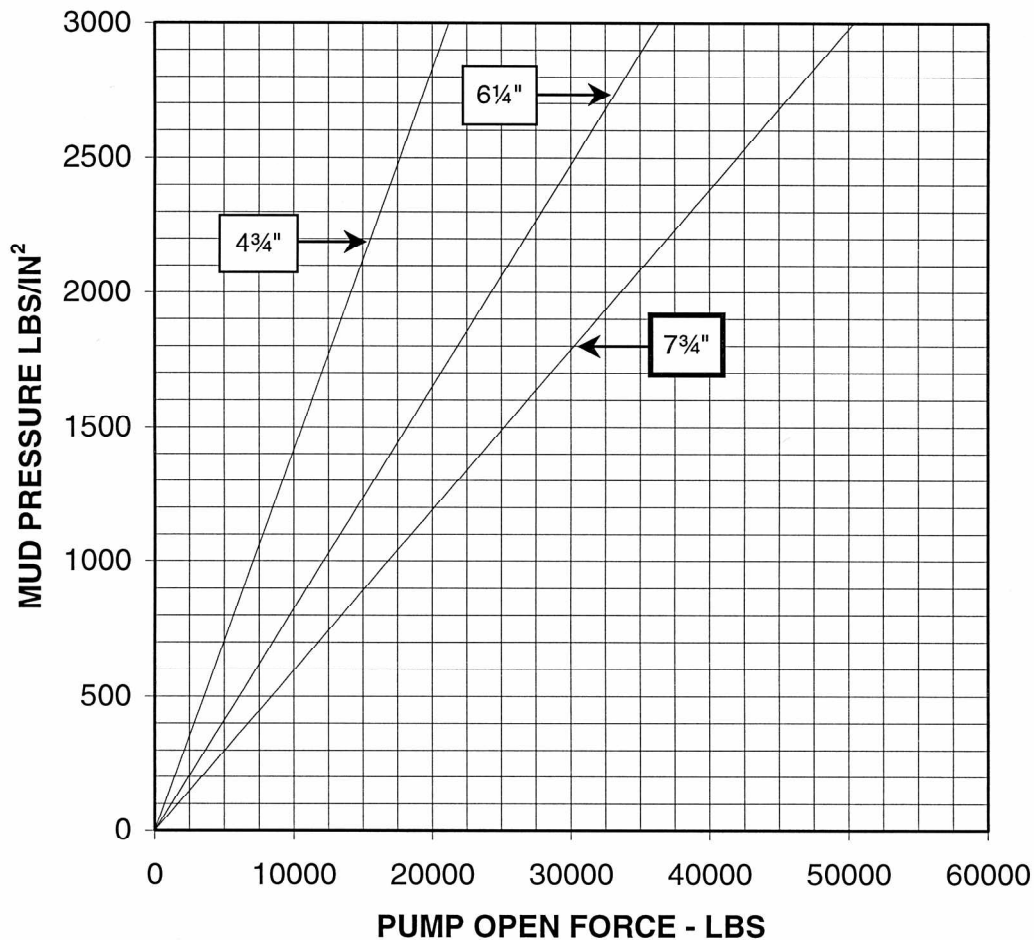


Figure 5.1
PowerStroke Pump Open Force Chart

5.0 Pump Open Force

The pump open force is that force developed by the differential pump pressure acting on the internal Washpipe area of a stroking tool. Its effect has a tendency to pump the tool open (Figure 5.1).

5.1 Effect on Up Jar Section

Circulating makes the Jar harder to cock. It also adds to the desired jarring effect that the operator is attempting to place on the Jar. For example, a 30,000 lbs pump open force plus a jarring load of 100,000 lbs, will yield an actual upward jarring force of 130,000 lbs.

5.2 Effect on Down Jar Section

Circulating makes the Jar harder to trip by holding the tool open. The pump open force must be added to the desired down jarring load when attempting to trip the Jar.

5.3 To Jar Up (with Pump Pressure)

Weight above Jar = weight indicator – weight below Jar – loss due to friction (usually 0 in straight holes)

Pump open force = circulation pressure x pump open area

Pull to trip Jar = weight above Jar + desired jar load + weight indicator error + increased friction due to movement
– pump open force

Examples:

Straight Hole

Weight above Jar = 262,000 – 18,500 – 0 = 243,500 lbs.

Pump open force = 500 psi x 12.2 in² = 6,100 lbs.

Pull to trip Jar = 243,500 + 120,000 + 6,000 + 5,000 – 6,100 = 368,400 lbs.

Deviated Hole

Weight above Jar = 262,000 – 18,500 – 30,000 = 213,500 lbs.

Pump Open Force = 500 psi x 12.2 in² = 6,100 lbs.

Pull to trip Jar = 213,500 + 120,000 + 6,000 + 45,000 – 6,100 = 378,400 lbs.

NOTE: Pump open force + friction drag must be exceeded when slacking off to cock the Jar.

5.4 To Jar Down (with Pump Pressure)

Weight above Jar at neutral = weight indicator at neutral – loss due to friction (usually 0 in straight holes)

Pump open force = circulation pressure x pump open area

Weight left on the indicator to trip Jar = weight above Drilling Jar at neutral – desired jar load – weight indicator error
– increased friction due to movement – pump open force

Examples:

Straight Hole

Weight above Jar at neutral = 243,500 – 0 = 243,500 lbs.

Pump open force = 500 psi x 12.2 in² = 6,100 lbs.

Weight left on indicator to trip Jar = 243,500 – 120,000 – 6,000 – 5,000 – 6,100 = 106,400 lbs.

Crooked Hole

Weight above Jar = 243,500 – 30,000 = 213,500 lbs.

Pump open force = 500 psi x 12.2 in² = 6,100 lbs.

Weight left on indicator to trip Jar = 213,500 – 120,000 – 6,000 – 45,000 – 6,100 = 36,400 lbs.

6.0 Troubleshooting

6.1 Jar Will Not Fire Up

The Jar may not be cocked. Try setting down more weight on the tool and “working” the load down if in a crooked or deviated hole. Pump pressure may be holding the tool open if circulating and this will require additional down force to be put on the tool to “cock” it. Try reducing pump pressure (See Pump Open Force Chart, page 8).

Friction of crooked holes may be absorbing the pull load before it reaches the Jar. Try heavier loads and wait longer for the Jar to trip.

Metering grooves in the Cone may be plugged from contamination in the Jar’s oil. Rapid up and down movement of the Jar should flush out the groove.

If the Jar strokes, but will not hit, the tool could be damaged or low on oil. The Jar must be redressed and refilled.

The Jar may be filled with the wrong type of oil. Some oils become too viscous at high pressures to meter through the Cone grooves. The Jar must be redressed with the correct oil.

6.2 Jar Will Not Fire Down

The load may not be getting to the Jar. Try a heavier load or try “working” the load down if the hole is deep or crooked. Try reducing pump pressure (See Pump Open Force Chart, page 8).

Jar may not be cocked. Repeat cocking procedure.

Metering grooves in the Cone may be plugged from contamination in the Jar’s oil. Rapid up and down movement of the Jar should flush out the groove.

If the Jar strokes, but will not hit, the tool could be damaged or low on oil. The Jar must be redressed and refilled.

The Jar may be filled with the wrong type of oil. Some oils become too viscous at high pressures to meter through the Cone grooves. The Jar must be redressed with the correct oil.

If circulating while jarring, pump pressure may be holding the Jar open, use more weight or cut back on the pump pressure.

In deep or crooked holes it may be difficult to observe the Jar firing on the rig floor.

7.0 Maintenance

There are generally two types of maintenance required for the PowerStroke Drilling Jar; Rig Floor Maintenance, after moderate use or on a short duration job, and Dressing Area Maintenance after prolonged and/or hard use.

7.1 Rig Floor Maintenance

After moderate use and when the Jar is to be kept at the rig site, pull the tool through the rig floor and wash all the mud from the exterior of the Jar.

CAUTION: Avoid any action that could cock the Up section of the Jar.

Flush all mud from the exposed Mandrel, Washpipe, and Washpipe Body. There are balance ports in the Spline Body that need to be flushed out when it is expected that the Jar will be laying on the rig floor for some length of time. If the holes are allowed to be exposed to air for a long period of time the, mud inside this area can dry out and keep the Jar from stroking during its next operation. Flush this area from all the ports so as to remove as much of the mud as possible. After the tool has been thoroughly washed, spray it down inside and out with a water displacing oil, if available. If the tool is to be run again, it may be “racked” with the drill collars or heavy-weight pipe. Be sure the Safety Collar is

on the Jar before it is “racked.” If the Jar is to be laid down, prior to storage, coat the pin and box connection with a high quality thread lubricant and install thread protectors on the tool joints. The tool should be stored horizontally and sprayed with a light oil to prevent rust from forming on exposed areas, such as the Mandrel and Washpipe.

7.2 Dressing Area Maintenance

After prolonged and/or hard use, the National Oilwell PowerStroke Jar should be taken to an adequate dressing area to be completely disassembled, cleaned, inspected, repaired as required and reassembled. It is recommended the tool be serviced at intervals not to exceed 30 days or 500 rotary hours running time or between jobs. If heavy jarring has been done, the tool should be serviced as soon as possible after it is removed from the hole. If the Jar is exposed to very high temperatures, it should be redressed after about 300 rotary hours or after very high RPMs.

The following list of tools are required to redress the PowerStroke Jar.

- (1 ea) Floor Vise (suitable for the Jar size)
- (1 ea) Overhead Crane (2,000 lb. capacity minimum)
- (1 ea) Tong (suitable for the Jar OD)
- (2 ea) Pipe Wrenches (suitable for the ODs of internal parts)
- (2 ea) Adjustable Support Stands with rollers (or a pulley and belt system, which can be suspended from the crane for spinning off / on threaded parts)
- (1 ea) Adjustable Spanner Wrench
- (2 ea) Fill Plug Adapter (for 1/4" NPT 102025 Fill Plug) – Bowen Part No. 102031

- (2 ea) Fill Plug Adapter (for 1/4" NPT 80900 Fill Plug) – Bowen Part No. 81377
- (1 ea) 3/8" Fill Plug Wrench (for 8" OD Jar) – Bowen Pt. No. 38673
- (1 ea) Snap Ring Pliers – Bowen Part No. 77216
- (1 ea) Jar Service Kit (This Jar Service Kit contains the most common items, including lube pump, required to service National Oilwell Jars) – Bowen Part No. 55403
- (1 ea) All Special Seal and Packing assembly/disassembly tools that are required for your specific tool (see Optional Extras Section on page 34)
- (1 ea) Bowen Jar Tester or equivalent

CAUTION: To prevent damage to the threads in the Fill Plug and Control Ring plug holes during the redress operation, DO NOT PLACE THEM IN THE VISE JAWS OF THE SERVICE UNIT.

8.0 Disassembly

WARNING: DO NOT REMOVE FILL PLUGS (29 AND 50) OR WASHPIPE BODY (64) FIRST. INTERNAL RESIDUAL WELL PRESSURE MAY EXIST WITHIN THE DRILLING JAR AND CAN CAUSE SERIOUS INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT (SEE STEP 8.2 BELOW).

CAUTION: Support the Drilling Jar Bodies being removed with a belt pulley system to prevent galling of the threads from the unsupported weight of the Drilling Jar.

NOTES: For Disassembly, the PowerStroke Drilling Jar should be in the open position so the Cones are in the free areas of the Pressure Body. If the Jar is not open, put the Jar in a Jar Tester and stroke it open before you start to disassemble the Jar.

Refer to Figure 8.1 for the 4-3/4" Drilling Jar, Figure 8.2 for the 6-1/4" and 6-1/2" Drilling Jar and Figure 8.3 for the 7-3/4" and 8" Drilling Jar for disassembly.

8.1 Position Drilling Jar in Breakout Unit and break all body connections, placing a bucket under Drilling Jar to catch any leakage of hydraulic oil.

8.2 Unscrew the connection between Pressure Body (43) and Floater Body (44) (connection nearest the lower Fill Plug (50)) enough to break the seal between the two bodies in order to release any stored well pressure inside the Drilling Jar.

8.3 Oil may be allowed to drain into bucket from connection or connection may be screwed back together to reseal and stop leakage if desired before moving to vise.

8.4 Using a Crane, lift the Jar into the floor vise. The Jar should be centered in the vise as close as possible to the joint being removed. Set the Jar on the Washpipe Body (64) in the floor vise. Also support the Mandrel Body (4) with the Adjustable Support Stand.

NOTE: The threads are RIGHT HAND in all areas except for the Mandrel Body (4) to the Spline Body connection (1), which is LEFT HAND.

8.5 Remove the Bottom Sub (67) from the Washpipe Body (64). The threads are RIGHT HAND in all areas except for the Mandrel Body (4) to the Spline Body connection (1), which is LEFT HAND.

8.6 Reposition Drilling Jar down to the Floater Body (44) in the floor vise.

8.7 Remove the Washpipe Body (64) from Floater Body (44).

8.8 Reposition Drilling Jar down to the Pressure Body (43) in the floor vise.

NOTE: Have a bucket ready to catch the oil that will spill out when you remove the Floater Body (44).

The Floater (53) will usually come out with the Floater Body (44), so position the bucket at the connection of the Floater Body and Pressure Body (43).

8.9 Remove the Floater Body (44) from the Pressure Body (43). The Floater (53) can be removed from the Floater Body with a brass rod. Insert the rod from the pin connection end, and bump it out.

8.10 Reposition Drilling Jar down to the Connector Body (22) in the floor vise.

8.11 Remove the Pressure Body (43) from the Connector Body (22).

CAUTION: The Down Cone (33), the Seal Body (35), and the By-Pass Body (34) (6-1/4" OD and 7-3/4" OD) will probably come off with the Washpipe (42). Care should be taken not to damage these parts.

NOTES: Be careful to wrench/tong only in designated areas.

Any minor damage and burrs should be repaired by hand, using files or emery cloth.

8.12 Remove the Washpipe (42) and Washpipe Extension (63) together. You can remove the Washpipe Extension from the Washpipe later.

8.13 Remove the Washpipe Connector (39) from the Mandrel Extension (12).

8.14 Remove the Up Cone (32) and Seal Body (35), and the By-Pass Body (34) (6-1/4" OD and 7-3/4" OD) from the Mandrel Extension (12).

8.15 For the 4-3/4" Drilling Jar (ONLY), reposition the Jar down to the Connector Body Packing Adapter (18) and for the 6-1/4" and 7-3/4" Drilling Jars reposition the Jars to the Spline Body (1) in the floor vise.

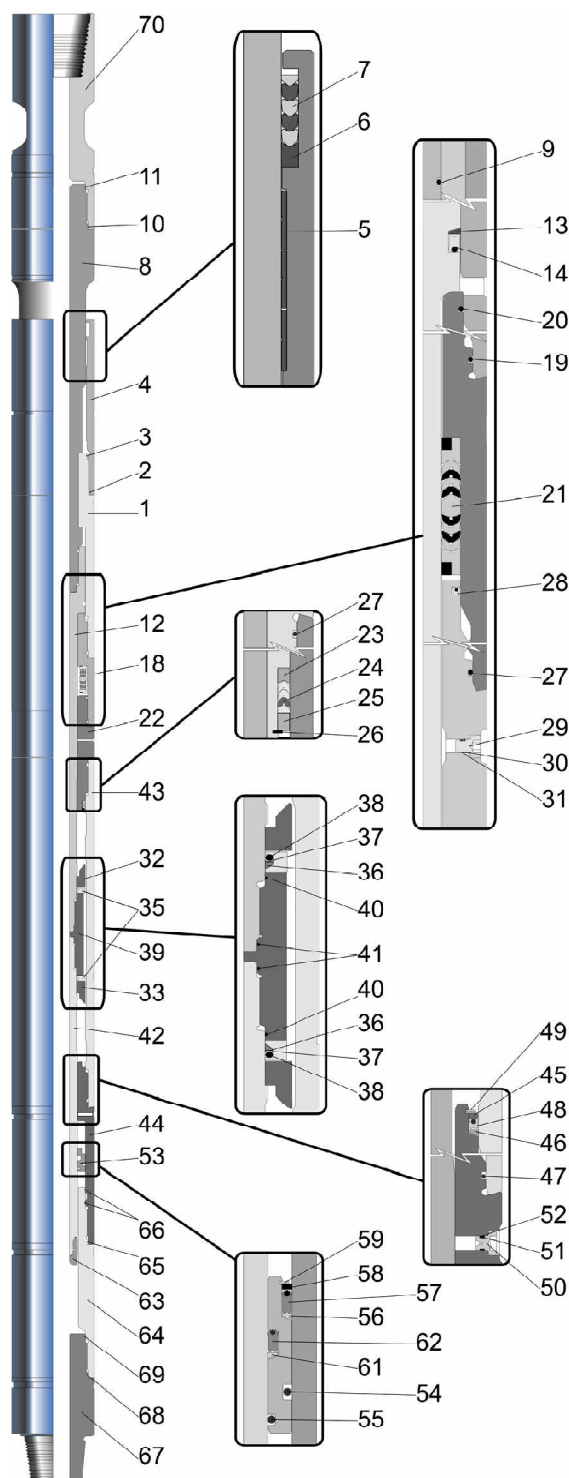
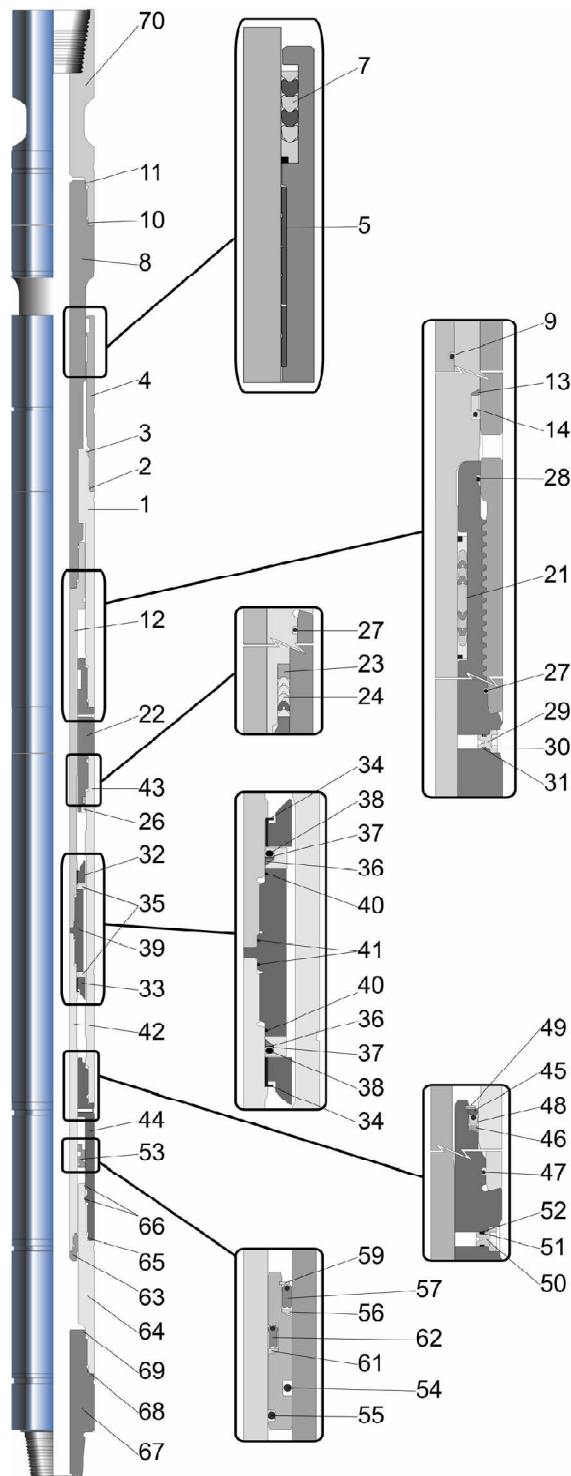


Figure 8.1
4-3/4" Drilling Jar

Item #	Part Description	Part #
1	SPLINE BODY	156354
2	O.D. SEAL (LARGE)	568243
3	O.D. SEAL (SMALL)	568241
4	MANDREL BODY	156355
5	BEARING 3 Req'd	154383
6	FEMALE ADAPTER	154382
7	PACKING SET	154381
8	MANDREL	156356
9	MANDREL SMALL END SEAL	568231
10	O.D. SEAL (LARGE)	568242
11	O.D. SEAL (SMALL)	568239
12	MANDREL EXTENSION	156357
13	NON-EXT. RING	156401
14	O.D. SEAL	156402
18	PACKING ADAPTER	156396
19	SEAL (LARGE)	568242
20	SEAL (SMALL)	568239
21	I.D. PACKING SET	156403
22	CONNECTOR BODY	156358
23	FEMALE ADAPTER	102387
24	PRESSURE RING SET	102400
25	BACK UP RETAINER RING	156405
26	RETAINER RING	156731
27	SEAL (LARGE) 2 Req'd	568242
28	SEAL (SMALL)	156732
29	FILL PLUG	102025
30	BACK UP RING	8/091
31	SEAL	568010
32	CONE (UP)	156360
33	CONE (DOWN)	156462
35	SEAL BODY 2 Req'd	156361
36	NON-EXT. RING 2 Req'd	370/080
37	SEAL PROTECTOR 2 Req'd	376/085
38	SEAL 2 Req'd	568233
39	WASHPIPE CONNECTOR	156362
40	SEAL (LARGE) 2 Req'd	568233
41	SEAL (SMALL) 2 Req'd	568231
42	WASHPIPE	156363
43	PRESSURE BODY	156364
44	FLOATER BODY	156365
45	BACKUP RETAINER	156408
46	NON-EXT. RING	156410
47	O.D. SEAL (LARGE)	568242
48	O.D. SEAL (SMALL)	156536
49	RETAINER RING	156411
50	FILL PLUG	102025
51	BACKUP RING	8/091
52	SEAL	568010
53	FLOATER	156366
54	SEAL	568341
55	SEAL	568337
56	NON-EXT. RING	156414
57	O.D. SEAL	156537
58	BACKUP RETAINER RING	156412
59	RETAINER RING	156411
61	NON-EXT. RING	364/015
62	I.D. SEAL	156415
63	WASHPIPE EXTENSION	156367
64	WASHPIPE BODY	156368
65	SEAL O.D. (LARGE)	568242
66	SEAL O.D. (SMALL) 2 Req'd	568239
67	BOTTOM SUB	156369
68	SEAL O.D. (LARGE)	568242
69	SEAL O.D. (SMALL)	568239
70	FLEX SUB	156371



Item #	Part Description	Part #
1	SPLINE BODY	155791
2	O.D. SEAL (LARGE)	568254
3	O.D. SEAL (SMALL)	568251
4	MANDREL BODY	155792
5	BEARING 3 Req'd	155793
7	PACKING SET	155794
8	MANDREL	155795
9	SEAL	568238
10	O.D. SEAL (LARGE)	568252
11	O.D. SEAL (SMALL)	568249
12	MANDREL EXTENSION	156106
13	NON-EXT. RING	155797
14	O.D. SEAL	155798
21	I.D. PACKING SET	155800
22	CONNECTOR BODY	155799
23	FEMALE ADAPTER	102381
24	PRESSURE RING SET	102411
26	RETAINER RING	68200
27	SEAL (LARGE) 2 Req'd	568252
28	SEAL (SMALL)	568249
29	FILL PLUG	102025
30	BACK UP RING	8/091
31	SEAL	568010
32	CONE (UP)	68203
33	CONE (DOWN)	156337
34	BY-PASS BODY 2 Req'd	68361
35	SEAL BODY 2 Req'd	68204
36	NON-EXT. RING 2 Req'd	102251
37	SEAL PROTECTOR 2 Req'd	102250
38	SEAL 2 Req'd	568343
39	WASHPIPE CONNECTOR	155803
40	SEAL (LARGE) 2 Req'd	568240
41	SEAL (SMALL) 2 Req'd	568237
42	WASHPIPE	156199
43	PRESSURE BODY	155805
44	FLOATER BODY	156198
45	BACKUP RETAINER	156209
46	NON-EXT. RING	155807
47	O.D. SEAL (LARGE)	568252
48	O.D. SEAL (SMALL)	155808
49	RETAINER RING	155809
50	FILL PLUG	102025
51	BACKUP RING	8/091
52	SEAL	568010
53	FLOATER	155810
54	SEAL	568426
55	SEAL	568345
56	NON-EXT. RING	155811
57	O.D. SEAL	155798
59	RETAINER RING	155809
61	NON-EXT. RING	155814
62	I.D. SEAL	155815
63	WASHPIPE EXTENSION	156210
64	WASHPIPE BODY	156211
65	SEAL (LARGE)	568252
66	SEAL (SMALL) 2 Req'd	568249
67	BOTTOM SUB	156340
68	SEAL(LARGE)	568252
69	SEAL (SMALL)	568249
70	FLEX SUB	156339

Figure 8.2
6-1/4" and 6-1/2" Drilling Jars

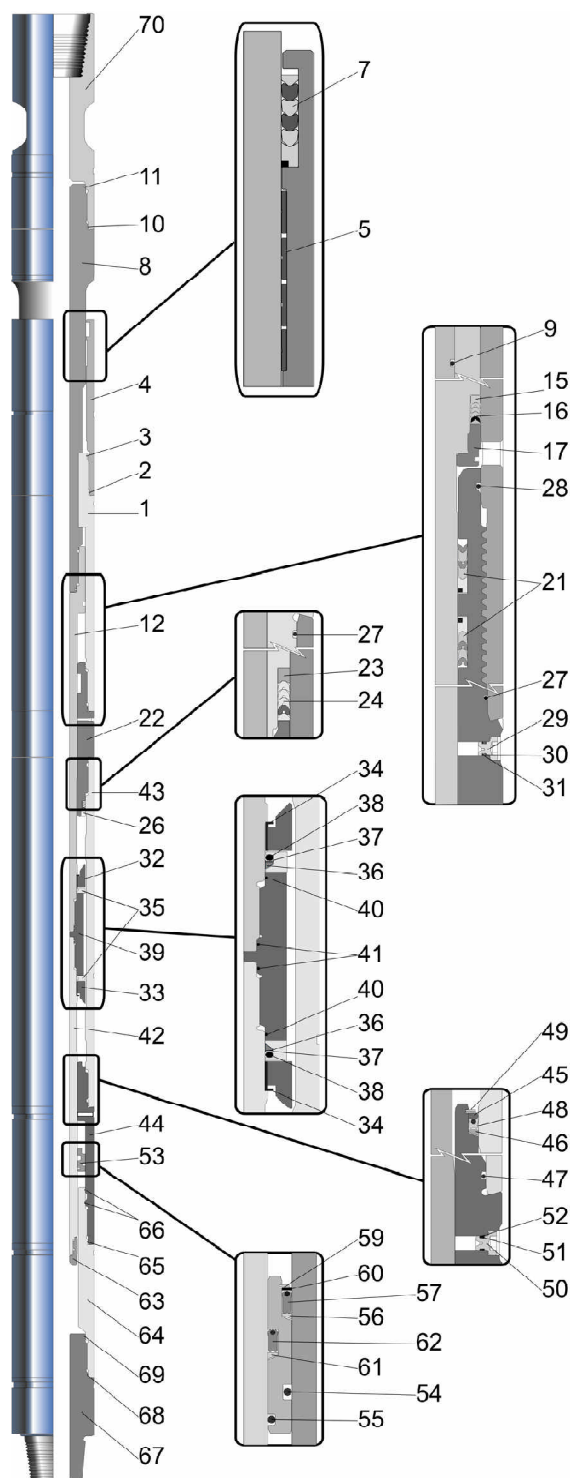


Figure 8.3
7-3/4" and 8" Drilling Jars

Item #	Part Description	Part #
1	SPLINE BODY	156427
2	O.D. SEAL (LARGE)	568243
3	O.D. SEAL (SMALL)	568259
4	MANDREL BODY	156428
5	BEARING 4 Req'd	156444
7	PACKING SET	156445
8	MANDREL	156429
9	SEAL	568245
10	SEAL (LARGE)	568259
11	SEAL (SMALL)	568257
12	MANDREL EXTENSION	156430
13	MIDDLE PACKING RING	102385
14	PACKING SET	69261
18	PACKING RETAINER	156431
21	I.D. PACKING SET 2 Req'd	156446
22	CONNECTOR BODY	156432
23	FEMALE ADAPTER	102379
24	PRESSURE RING SET	102413
26	RETAINER RING	69272
27	SEAL (LARGE) 2 Req'd	568259
28	SEAL (SMALL)	568257
29	FILL PLUG	80900
30	BACK UP RING	8/108
31	SEAL	568108
32	CONE (UP)	69275
33	CONE (DOWN)	156433
34	BY-PASS BODY	69277
35	SEAL BODY 2 Req'd	69276
36	NON-EXTRUSION RING 2 Req'd	102253
37	SEAL PROTECTOR 2 Req'd	148499
38	SEAL 2 Req'd	568349
39	WASHPIPE CONNECTOR	156434
40	SEAL (LARGE) 2 Req'd	568246
41	SEAL (SMALL) 2 Req'd	568242
42	WASHPIPE	156435
43	PRESSURE BODY	156436
44	FLOATER BODY	156437
45	BACKUP RETAINER	156447
46	NON-EXTRUSION RING	156448
47	SEAL (LARGE)	568259
48	SEAL (SMALL)	156449
49	RETAINER RING	156450
50	FILL PLUG	80900
51	BACKUP RING	8/108
52	SEAL	568108
53	FLOATER	156451
54	SEAL	568434
55	SEAL	568350
56	NON-EXTRUSION RING	156452
57	O.D. SEAL	156453
59	RETAINER RING	156450
60	SEAL PROTECTOR RING	156458
61	NON-EXTRUSION RING	156455
62	I.D. SEAL	156456
63	WASHPIPE EXTENSION	156438
64	WASHPIPE BODY	156439
65	SEAL (LARGE)	568259
66	SEAL (SMALL) 2 Req'd	568257
67	BOTTOM SUB	156440
68	SEAL (LARGE)	568259
69	SEAL (SMALL)	568257
70	FLEX SUB	156433

8.16 For the 6-1/4" and 7-3/4" Drilling Jars, remove the Connector Body (22) from the Spline Body (1).

8.17 For the 4-3/4" Drilling Jar, remove the Connector Body (22) from the Connector Body Packing Adapter (18).

8.18 For the 4-3/4" Drilling Jar (ONLY), reposition the Jar down to the Spline Body (1) in the floor vise.

8.19 For the 4-3/4" Drilling Jar (ONLY), remove the Connector Body Packing Adapter (18) from the Spline Body (1).

NOTE: For the remainder of the disassembly leave the Spline Body (1) in the floor vise.

8.20 Remove the Mandrel Extension (12) from the Mandrel (8).

8.21 Remove Flex Sub (70) from the Mandrel (8).

8.22 Remove the Mandrel (8) from the Mandrel Body (4).

NOTE: Threads on Mandrel Body (4) are left hand.

8.23 Remove the Mandrel Body (4) from the Spline Body (1).

8.24 Remove the Spline Body (1) from the floor vise and place it on a pallet with the other parts.

CAUTION: Always wear eye protection when using a high-pressure washer.

8.25 Remove all seals and packing from the disassembled parts and wash them with a high-pressure washer.

9.0 Inspection Procedure

9.1 In preparation for inspection, thoroughly clean all parts with solvent and dry with a clean, lint-free cloth. Parts must be free of grease, oil, mud, etc. Rust and scale must be removed from all ODs and IDs of parts. Severe rust pitting is unacceptable in any area.

WARNING: Always watch for sharp pieces of metal when inspecting threads. Wear gloves or suitable protection while doing the inspection.

NOTE: After the Jar parts have been stripped of all packing and cleaned, you should arrange them so they can be inspected for any damage that might have occurred on the previous job or during the disassembly of the tool.

9.2 All parts should be inspected for pits, excessive wear, cracks, scratches, galled areas, burrs, etc. Minor damage and burrs may be repaired by hand, using files or emery cloth. Parts that cannot be repaired by hand must be sent for rework or scrapped.

Any damaged areas left unrepaired can cause additional damage to that part and possibly other parts during future use.

9.3 Clean all parts following repair and polishing. Make sure no steel filings, rust, grease, or dirt remain on the parts.

Parts with any crack indications should be replaced.

9.4 Inspect all threaded connections, fillets, portholes, cross-sectional area changes, and other high stress areas for cracks using wet-fluorescent magnetic-particle method ASTM E709, or equivalent. Personnel shall be qualified in accordance with SNT-TC-1A or equivalent. National Oilwell's Engineering Specification SS#200-238 may be referenced for acceptance criteria.

NOTE: Outside Body wear due to rotary cycles is acceptable as long as it is within the acceptable tolerances as noted by the manufacturer. If you are in doubt about any part, it should probably be replaced.

9.5 Rotary-shouldered connections should be inspected and repaired in accordance with Section 12 of API Recommended Practice 7G, 15th Ed., January 1, 1995. Minor damage to threads may be removed with a triangular hand file and then polished with fine emery cloth.

NOTE: Cracks can develop from cycle fatigue during any job due to severe hole conditions, therefore, it is recommended to always check for cracks in highly stressed areas.

9.6 Visually inspect all components and surfaces exposed to well fluids for wear, pitting, or scaling in the bores.

9.7 Visually inspect all sealing surfaces and seal/O-Ring grooves for damage or corrosion. Sealing surfaces must be smooth to create a proper seal and to prevent damage to O-rings, seals, or packing. Any abrasions on O-Ring grooves or seal surfaces can damage the seals and result in a loss of fluid during the operation of the tool.

9.8 Wear rings on the Mandrel Body (4) should be replaced when the machined grooves are no longer visible on the ID of the wear rings. Close attention to wear ring replacement will minimize the wear to seal lands and increase the life of the seals.

NOTE: If the sealing face of a Cone is lapped, the metering groove must be remachined. The mating faces of the Cones and Seal Bodies must seal perfectly, except the machined scratch.

9.9 Examine Cones (32 & 33) and Seal Bodies (35) for damage or excessive wear. Polish off any damage with a very fine emery cloth. Make sure to check that the Cones are not out of round by measuring the OD in more than one axis. The mating surfaces of the Cones and Seal Bodies should be smooth and

flat. Any scratches, burrs, or pitting on these surfaces should be lapped out. If any damage on the Cones or Seal Bodies cannot be polished out, replace the damaged part(s).

- 9.10 Examine the chromed bore of the Pressure Body (43). Minor damage should be repaired using a very fine emery cloth. If damage cannot be repaired in this manner, the part must be reworked or replaced.

NOTE: The OD of the Cone is slightly larger than the Pressure Body ID, which results in an interference fit.

- 9.11 Carefully inspect the IDs of the up and down metering sections (restriction areas). These are the reduced ID areas of the Pressure Body (43) against which the Cones seal during jarring. This will be the smallest measured diameter in the top half of the Pressure Body (for up jarring) and the smallest measured diameter in the lower half of the Pressure Body (for down jarring).

- 9.12 Inspect the splines on the Mandrel (8) and Spline Body (1) for burrs or up-sets. Remove any damage with a hand grinder or file, and afterwards polish the area with a fine emery cloth.

- 9.13 The Mandrel Extension (12) should be checked for "necking" in the Up-Cone area. Necking is a loss of diameter due to tensile loads that exceed the material's yield strength and result in the part stretching. Use a micrometer or straight edge to inspect the Cone (32) area for necking.

- 9.14 Examine the shoulder that retains the Cone (32) on the Mandrel Extension (12). It must be square and smooth to properly hold the

Cone in place. Perform the same inspection on the retaining shoulder at the upper end of the Washpipe (42).

- 9.15 Visually inspect the impact areas of the Jar, the areas where the metal parts hit during operation, for upset metal or cracks.

NOTE: Metal seal protector rings, Non-Extrusion rings, Male and Female Packing Adapters are designed to last for long periods of time, therefore, inspection is required but replacement is not necessary at each redress. Monitor wear and replace only when needed.

- 9.16 The knocker surfaces for up jarring are the shoulder inside the Spline Body (1) (formed by the splines) and the box face on the Mandrel Extension (12). The knocker surfaces for down jarring in the 4-3/4" Jars are the pin face on the Connector Body Packing Adapter (18) and the external shoulder on the Mandrel Extension. For the 6-1/4" and 7-3/4" Jars, the knocker surfaces are the pin face on the Connector Body (22) and the external shoulder on the Mandrel Extension.

Examine these knocker surfaces for damage. Remove upset material and sharp corners with a hand grinder or file followed by polishing the area with a fine emery cloth.

- 9.17 Seals, O-Rings, packing, wipers, and Fill Plugs are to be replaced during dressing area maintenance. However, inspection of these parts may help detect other damage in the Jar.

- 9.18 If the Jar is not to be assembled soon after inspection, apply a light coat of oil to each part. Place the parts on clean, lint-free cloths.

10.0 Replacing the Seals and Packing the Jar

When replacing the seals and packing in the tool it is a good idea to have the assembly drawing or this instruction manual handy so you can see how to install the seals and packing. All packing requires that the designed lip be facing a certain direction due to pressure, therefore, improper installation will result in tool failure.

NOTE: The Drilling Jar will not reassemble if the Copper Rings have not been resized after installation. See Section 7.2 Dressing Area Maintenance, page 18 for setting tool part numbers.

All Copper Seal Protector and Non-Extrusion Rings require a setting tool be used to resize them after assembly, therefore, you should have these tools available in your redress areas.

11.0 Assembly Procedure

NOTES: Before starting the assembly lets take a few minutes and talk about Shop safety and procedures. Always use the proper sling for lifting heavy parts. Make sure the hoist is in good repair and has the capacity for your job. Wear eye protection. Wear steel-toed shoes and back support. Use a rotary sling for supporting parts during the thread make up. The rotary sling allows you to spin the part when starting threads.

Always lubricate the threads with an approved thread lubricant (KOPR-KOTE). Keep the thread lubricant between the elastomer seals on the connections. If the lubricant is allowed to get into the hydraulic oil it can cause problems during operation due to particles plugging up the metering orifice of the tool.

- 11.1 Make sure all parts have been thoroughly washed and are clean. Take time to inspect all parts for burrs, damaged threads and damaged seal areas before assembly. Arrange the parts in a clean work area with all seals and packing required for the assembly. Refer to Figure 8.1 for the 4-3/4" Drilling Jar,

Figure 8.2 for the 6-1/4" and 6-1/2" Drilling Jar, and Figure 8.3 for the 7-3/4" and 8" Drilling Jar for assembly.

CAUTION: Many areas of this Drilling Jar are extremely sensitive to cleanliness for proper operation. Even the smallest particles or contaminants can plug the metering orifice.

11.2 Starting with the Mandrel Body (4), dress all parts with the proper seals and packing.

11.3 Lift the Spline Body (1) into the floor vise and secure it with the chain clamp. The vise Jaws should be resting on the Body right behind the pin thread. Lubricate the pin thread of the Spline Body with thread lubricant.

NOTE: The threads on the Mandrel Body Box and the Spline Body PIN are LEFT HAND; care should be taken at this point. These threads are left hand to prevent back off due to rotational friction above the Spline Body during operation.

11.4 Install the Mandrel Body (4) onto the pin thread end of the Spline Body (1). Make the connection up until it shoulders, but do not torque it to the recommended specification at this time, wait until the entire Drilling Jar is assembled before final torque is applied to the outside bodies.

NOTE: Coat the Splines on the Mandrel liberally with thread lubricant.

11.5 Install the Mandrel (8) into the Mandrel Body (4) and Spline Body (1), make sure the small pin thread has been lubricated. Push the Mandrel in until it hits the splines in the Spline Body. Rotate the Mandrel slowly in either the clock wise or counter-clockwise direction until the splines line up. Push the Mandrel in until there is a space of 12 to 15 inches exposed at the area

between the Mandrel Body and Mandrel shoulder at the large pin connection of the Mandrel.

11.6 Install the Mandrel Extension (12) into the Spline Body (1) until it bumps up against the end of the Mandrel (8). Carefully rotate the Mandrel Extension clockwise until the threads start to engage. After you are sure that the threads have engaged, continue rotating until the connection is tight. Torque this connection to the required value that is recommended on page 40 of this manual.

NOTE: The 4-3/4" OD Drilling Jar has a Connector Body Packing Adapter (18). The 6-1/2" OD and 7-3/4" OD Drilling Jars do not have this.

11.7 Install the Connector Body Packing Adapter (18) (4-3/4" OD Drilling Jar only). Make sure the pin thread is lubricated.

11.8 Push or pull the tool all the way open, until the end of the Mandrel Extension (12) hits the splines in the Spline Body (1).

11.9 Install the Connector Body (22) over the Mandrel Extension (12) with the end that has the packing and Retainer facing the bottom of the Jar. Make sure the pin thread being installed has been lubricated.

11.10 At this point the Jar needs to be moved in the vise to better balance it for further assembly. Support the Jar with a hoist and sling then loosen the hold down chain and release the tool from the vise. Slide the tool down so that the Connector Body (22) rests in the vise jaws. Tighten the hold down chain to secure the tool and continue with the assembly of the tool.

NOTE: The Up Cone (32) and the Down Cone (33) are not the same; make sure you have the proper part number for the location being installed.

11.11 Install the By-Pass Body (34) (if applicable), Up Cone (32) and Seal Body (35) onto the Mandrel Extension (12) with the thin cone lip facing the top of the Jar. Make sure the Cone is well lubricated with a light hydraulic oil. Lubricate the pin connection of the Mandrel Extension with thread lubricant.

11.12 Install the Washpipe Connector (39) and torque it to the required load on page 31.

11.13 Install the Down Jarring By-Pass Body (34) (if applicable), Down Cone (33) and Seal Body (35) onto the Washpipe (42). Make sure you have installed the Cone's thin lip facing the bottom of the Jar.

11.14 Install the Washpipe (42) into the Washpipe Connector (39); make sure that you lubricate the pin thread before installing. Torque it to the required load on page 31.

11.15 Make sure that the pin thread of the Washpipe (42) is lubricated. Install the Washpipe Extension cap (63) onto the end of the Washpipe. Torque it to the required load on page 31.

11.16 Install the Pressure Body (43) over the Washpipe (42) and onto the Connector Body (22). Lubricate the pin connection of the Connector Body first. The Pressure Body is stenciled to indicate which end is "Down" or next to the Floater Body (44).

CAUTION: The Jar will not work if the Up and Down Cones (32 and 33) are reversed, damage to the Pressure Body (43) or Cones can result.

NOTE: The Down Jarring Cone (33) is smaller than the Up Jarring Cone (32); therefore no resistance should be encountered during the assembly of the Pressure Body (43). If resistance is encountered the Cones are probably reversed.

11.17 Lubricate the pin connection of the Floater Body (44). Install the Floater Body over the Washpipe (42) and into the Pressure Body (43).

11.18 Install the Floater (53) onto the Washpipe (42). Make sure the floater end with the OD seal closest to the end of the Floater goes on first. See Figures 8.1, 8.2, and 8.3 for reference.

NOTE: The Floater (53) position will need to be set to a specific dimension from the box end Floater Body (44). See Table 11.1 Floater Position Settings on page 18 for required dimension.

11.19 Lubricate the pin thread on the Washpipe Body (64) with thread lubricant. Install the Washpipe Body over the Washpipe (43) and into the Floater Body (44).

CAUTION: To prevent accidental movement of the Floater (53), the Drilling Jar should not be stroked until the Jar has been completely filled with oil.

11.20 Lubricate the pin thread of the Bottom Sub (67). Install the Bottom Sub into the Washpipe Body (64).

11.21 The assembled Drilling Jar can be moved to the service center for final torque to be applied to all outside Body parts. See Section 14.0 MAXIMUM RECOMMENDED MAKE-UP TORQUE on page 19 for proper torque.

11.22 Lubricate the pin thread on the Mandrel (8) with thread lubricant. Install the Flex Sub (70) onto the Mandrel pin connection.

Drilling Jar	Measured Distance from End of Floater Body (44) to Floater (53)
4-3/4" Jar	9-7/8" to 10-3/8"
6-1/4" & 6-1/2" Jars	11-5/8" to 12-1/8"
7-3/4" Jar	12" to 12-1/4"

Table 11.1
Floater Position Settings

NOTES: For shorter Jar Testers, the Jar may be tested with out the Flex Sub (70) installed. A Jar Tester Sub can be provided for attachment to the Mandrel (8).

The tool should not be stroked until filling with oil is complete to prevent accidental movement of the Floater (53).

If Jar is tested and it is determined that excessive air still exists in the Jar; the Floater (53) will need to be reset. (Remove the Fill Plug (50) from the Floater Body (44), reset the Floater and then reassemble). If oil is added at any time after the Jar has been stroked, the Floater should be reset (See Table 11.1).

12.0 Filling the Jar with Oil

12.1 Before filling the Jar with oil, make sure that the Floater position was set during assembly. Do not move the Mandrel from the fully open position after the floater position has been set until filling is complete.

Position the Jar in a vise with the Mandrel End about 2 to 3 feet higher than the Bottom Sub End.

12.2 Rotate the tool until the Fill Plug hole in the Connector Body (22) is pointing straight up. This hole is for air to vent out of the tool, so it is very important that the hole is on top.

12.3 Install the proper Fill Plug vent adapter in the hole and connect it to the oil fill unit.

12.4 Connect the proper fill plug fill adapter to the Fill Plug hole located in the Floater Body (44).

NOTE: The Fill Plug hole in the Floater Body (44) can be in any position during the filling process, so don't be concerned if the hole is on the side or bottom of the Body.

12.5 Connect the fill hose to the oil fill pumping unit.

NOTES: Bowen P/N 49842 hydraulic oil is recommended but any ISO Grade 22 hydraulic oil having the required properties can be used, such as Sunvis 722 or Rando HD 22.

When filling the Jar, use steady strokes on the fill unit so as not to pump the Floater (53) down against the Washpipe Body (64). The Floater is positioned so that there is a specific amount of air space in the tool during downhole operation. This air space allows for thermal expansion of the oil. Downhole pressure keeps the Floater pushed up against the oil in the Jar. Therefore the Floater compensates for the thermal expansion of the oil due to temperature and hydrostatically balances the Jar.

When you get a steady stream of oil out of the air vent hose, without bubbles, the Jar is full.

12.6 After the Jar has been filled with oil, disconnect the air vent hose in the Connector Body (22) first and install the proper fill plug.

12.7 Rotate the Jar so that the lower Fill Plug (50) hole is on top. Remove the oil fill hose and install the proper Fill Plug quickly.

13.0 Testing the Jar

13.1 Install the proper test subs on the Jar and place in the Jar Tester; refer to Table 13.1 Pull Loads on page 19 of this manual for proper test loads.

13.2 Stroke the Jar to the neutral position in the tester.

NOTES: It is important and necessary to record the test data on a "Test Data Log Sheet." Record the assembly number, serial number; tool size and all test data such as test loads and pull times. This data is important for diagnosing future problems.

If the drilling Jar fails to test properly, it will have to be disassembled and the problem corrected before the Jar can be put in service.

13.3 In general, the pull times will vary from tool to tool due to the slight differences in tolerance, differences in air volumes remaining in the tool, and temperature variations. Also as the tool is tested, the times will decrease slightly with the number of pulls due to the tool heating up. The tool should be stroked through at least 2 times in both directions at the low pull load before proceeding to the high pull load. The purpose of the low pull load test is to verify that the tool is working properly before pulling at the higher test load.

13.4 Acceptable pull times in the UP direction could vary from as low as 12 seconds to a little over a minute. Typical UP pull times will be in the 20 second to 30 second range. Acceptable high load times in the DOWN direction could vary from 30 seconds to over 2 minutes.

13.5 Pull times downhole may vary significantly from the pull times in the shop. Temperature and pressure variations affect the oil properties, which directly affect the oil metering process. The loads that actually reach the tool are usually not known precisely, due to hole geometry and friction drag. Also, the load is rarely applied to the tool down-hole as quickly as in the Jar Tester.

Pull Loads

JAR	LOW LOAD (UP & DOWN)	HIGH LOAD (UP)	HIGH LOAD (DOWN)
4-3/4"	5 tons	25 tons	10 tons
6-1/4"	10 tons	50 tons	15 tons
7-3/4"	15 tons	50 tons	20 tons

Table 13.1
Pull Loads

14.0 Maximum Recommended Make-Up Torque Values

CONNECTION DESCRIPTION	TORQUE VALUES (ft-lb)		
Assembly Number	156353	155790	156426
Flex Sub - Mandrel	8100	21000	36400
Mandrel Body - Spline Body	5700	14600	35800
Spline Body - Connector Body	—	21000	48400
Spline Body - Connector Body Adapter	8100	—	—
Connector Body Adapter - Connector Body	8100	—	—
Connector Body - Pressure Body	8100	21000	48400
Pressure Body - Floater Body	8100	21000	48400
Floater Body - Washpipe Body	8100	21000	45600
Washpipe Body - Bottom Sub	8100	21000	45600
Mandrel - Mandrel Extension	2400	7700	18000
Mandrel Extension - Washpipe Connector	2100	5300	11600
Washpipe Connector - Washpipe	1700	4200	9300
Washpipe - Washpipe Extension	800	2500	5000

15.0 Specifications

PowerStroke Hydraulic Drilling Jars Specifications

Complete Assembly	4-3/4"	6-1/4" & 6-1/2"	7-3/4" & 8"
Part Number	156353	155790	156426
Weight (lbs)	1,500	2,400	4,500
Size Connection (Standard)	3-1/2" IF	4-1/2" IF	6-5/8" Reg
Minimum O.D. (in)	4-3/4	6-1/4	7-3/4
I.D. (in)	2-1/4"	2-3/4	3-1/16
Tool Length - Closed (ft)	27	28	28
Tool Length - Open (ft)	29	30.5	30.5
Total Stroke - Up Section (from neutral)	12"	14"	15"
Total Stroke - Down Section (from neutral)	12"	14"	15"
Torsional Yield (ft-lbs)	16,200	42,000	72,800
Maximum Lift Load After Jarring Yield (tons)	241	424	736
(lbs)	482,000	848,000	1,472,000
Maximum Up Jar Load (tons)	45	85	150
(lbs)	90,000	170,000	300,000
Maximum Down Jar Load (tons)	45	85	150
(lbs)	90,000	170,000	300,000
Pump Open Area (in ²)	7.1	12.2	16.8

16.0 Replacement Parts

PowerStroke Hydraulic Drilling Jars Replacement Parts

ITEM #	PART NAME		4-3/4" 156353	6-1/4" 155790	7-3/4" 156426
1	SPLINE BODY	PART NO.	156354	155791	156427
		WT./LBS.	94	219	450
4	MANDREL BODY	PART NO.	156355	155792	156428
		WT./LBS.	72	148	289
5	BEARING F/ MANDREL BODY	PART NO.	154383	155793	156444
		WT./LBS.	6	6	9
8	MANDREL	PART NO.	156356	155795	156429
		WT./LBS.	178	409	786
12	MANDREL EXTENSION	PART NO.	156357	156106	156430
		WT./LBS.	71	142	251
13	NON-EXTRUSION RING F/ MANDREL EXTENSION O.D. SEAL BOX END	PART NO.	156401	155797	—
		WT./LBS.	1/4	1/4	—
15	MIDDLE PACKING RING	PART NO.	—	—	102385
		WT./LBS.	—	—	—
17	PACKING RETAINER	PART NO.	—	—	156431
		WT./LBS.	—	—	—
18	CONNECTOR BODY PACKING ADAPTER	PART NO.	156396	—	—
		WT./LBS.	1/2	—	—
22	CONNECTOR BODY	PART NO.	156358	155799	156432
		WT./LBS.	45	93	153
23	FEMALE ADAPTER F/ CONNECTOR BODY O.D. PACKING	PART NO.	102387	102381	102379
		WT./LBS.	1/2	1/2	1/2
25	BACK UP RETAINER RING F/ CONNECTOR BODY O.D. PACKING	PART NO.	—	156405	—
		WT./LBS.	1/4	—	—
26	RETAINER RING F/ CONNECTOR BODY O.D. PACKING	PART NO.	156731	68200	69272
		WT./LBS.	1/2	1/2	1/2
29	FILL PLUG	PART NO.	102025	102025	80900
		WT./LBS.	1/4	1/4	1/4
32	CONE F/ UP JARRING	PART NO.	156360	68203	69275
		WT./LBS.	4	9	14
33	CONE F/ DOWN JARRING	PART NO.	156462	156337	156433
		WT./LBS.	4	9	14
34	BY-PASS BODY	PART NO.	—	68361	69277
	2 Req'd	WT./LBS.	—	3/4	3/4
35	SEAL BODY	PART NO.	156361	68204	69276
	2 Req'd	WT./LBS.	1	2	3
36	NON-EXTRUSION RING F/ SEAL BODY SEAL	PART NO.	370/080	102251	102253
	2 Req'd	WT./LBS.	1/4	1/4	1/4
37	SEAL PROTECTOR F/ SEAL BODY SEAL	PART NO.	376/085	102250	148499
	2 Req'd	WT./LBS.	1/8	1/8	1/8
39	WASHPIPE CONNECTOR	PART NO.	156362	155803	156434
		WT./LBS.	15	37	74
42	WASHPIPE	PART NO.	156363	156199	156435
		WT./LBS.	49	110	175
43	PRESSURE BODY	PART NO.	156364	155805	156436
		WT./LBS.	97	241	465
44	FLOATER BODY	PART NO.	156365	156198	156437
		WT./LBS.	39	109	169
45	BACKUP RETAINER F/ FLOATER BODY O.D. SEAL	PART NO.	156408	156209	156447
		WT./LBS.	1/2	1/2	1/2
46	NON-EXTRUSION RING F/ FLOATER BODY O.D. SEAL	PART NO.	156410	155807	156448
		WT./LBS.	1/4	1/4	1/4
49	RETAINER RING F/ FLOATER BODY O.D. SEAL	PART NO.	156411	155809	156450
		WT./LBS.	1/2	1/2	1/2

PowerStroke Hydraulic Drilling Jars Replacement Parts (continued)

50	FILL PLUG F/ FLOATER BODY	PART NO.	102025	102025	80900
		WT./LBS.	1/4	1/4	1/4
53	FLOATER	PART NO.	156366	155810	156451
		WT./LBS.	4	6	12
56	NON-EXTRUSION RING F/ FLOATER O.D. SEAL	PART NO.	156414	155811	156452
		WT./LBS.	1/4	1/4	1/4
58	BACKUP RETAINER RING	PART NO.	156412	—	—
		WT./LBS.	1/2	—	—
59	RETAINER RING F/ FLOATER O.D. SEAL	PART NO.	156411	155809	156450
		WT./LBS.	1/2	1/2	1/2
60	SEAL PROTECTOR RING F/ FLOATER O.D. SEAL	PART NO.	—	—	156458
		WT./LBS.	—	—	1/8
61	NON-EXT. RING F/ FLOATER I.D. SEAL	PART NO.	364/015	155814	156455
		WT./LBS.	1/4	1/4	1/4
63	WASHPipe EXTENSION	PART NO.	156367	156210	156438
		WT./LBS.	2	6	9
64	WASHPipe BODY	PART NO.	156368	156211	156439
		WT./LBS.	87	210	329
67	BOTTOM SUB W/ PIN CONNECTION	PART NO.	156369	156340	156440
		WT./LBS.	77	128	186
70	FLEX SUB W/ PIN CONNECTION STD.	PART NO.	156371	156339	156443
		WT./LBS.	222	340	417

Complete Packing Set

ITEM#	PART NAME		4-3/4" 156353	6-1/4" 155790	7-3/4" 156426
	O-RING PACKING SET	PART NO.	156370	156009	156441
		WT./LBS.	3	3	3
6	FEMALE ADAPTER	PART NO.	154382	—	—
		WT./LBS.	1/2	—	—
7	PACKING SET F/ MANDREL BODY	PART NO.	154381	155794	156445
		WT./LBS.	1/4	1/4	1/4
14	O.D. SEAL F/ MANDREL EXTENSION BOX END	PART NO.	156402	155798	—
		WT./LBS.	1/8	1/8	—
16	PACKING SET F/ MANDREL EXTENSION	PART NO.	—	—	69261
		WT./LBS.	—	—	—
21	I.D. PACKING SET F/ CONN. BODY 2 Req'd for 7-3/4"	PART NO.	156403	155800	156446
		WT./LBS.	1/4	1/4	1/4
24	PRESSURE RING SET F/ CONNECTOR BODY O.D.	PART NO.	102400	102411	102413
		WT./LBS.	1/4	1/4	1/4
28	SEAL F/ CONN. BODY OD (SMALL)	PART NO.	156732	—	—
		WT./LBS.	1/4	—	—
30	BACK UP RING F/ FILL PLUG SEAL	PART NO.	8/091	8/091	8/108
		WT./LBS.	1/8	1/8	1/8
48	O.D. SEAL F/ FLOATER BODY (SMALL)	PART NO.	156536	155808	156449
		WT./LBS.	1/8	1/8	1/8
51	BACKUP RING F/ FILL PLUG SEAL	PART NO.	8/091	8/091	8/108
		WT./LBS.	1/8	1/8	1/8
57	O.D. SEAL F/ FLOATER	PART NO.	156537	155798	156453
		WT./LBS.	1/8	1/8	1/8
62	I.D. SEAL F/ FLOATER	PART NO.	156415	155815	156456
		WT./LBS.	1/8	1/8	1/8

PowerStroke Hydraulic Drilling Jars Replacement Parts (continued)
O-Ring Packing Set

ITEM#	PART NAME		4-3/4" 156353	6-1/4" 155790	7-3/4" 156426
2	SPLINE BODY O.D. SEAL (LARGE)	PART NO.	568243	568254	568261
		WT./LBS.	1/8	1/8	1/8
3	SPLINE BODY O.D. SEAL (SMALL)	PART NO.	568241	568251	568259
		WT./LBS.	1/8	1/8	1/8
9	MANDREL SMALL END SEAL	PART NO.	568231	568238	568245
		WT./LBS.	1/8	1/8	1/8
10	MANDREL O.D. SEAL (LARGE)	PART NO.	568242	568252	568259
		WT./LBS.	1/8	1/8	1/8
11	MANDREL O.D. SEAL (SMALL)	PART NO.	568239	568249	568257
		WT./LBS.	1/8	1/8	1/8
19	SEAL F/ CONNECTOR BODY O.D. (LARGE)	PART NO.	568242	—	—
		WT./LBS.	1/8	—	—
20	SEAL F/ CONNECTOR BODY O.D. (SMALL)	PART NO.	568239	—	—
		WT./LBS.	1/8	—	—
27	SEAL F/ CONNECTOR BODY O.D. (LARGE)	PART NO.	568242	568252	568259
	2 Req'd	WT./LBS.	1/8	1/8	1/8
28	SEAL F/ CONNECTOR BODY O.D. (SMALL)	PART NO.	—	568249	568257
		WT./LBS.	—	1/8	1/8
31	SEAL F/ FILL PLUG	PART NO.	568010	568010	568108
		WT./LBS.	1/8	1/8	1/8
38	SEAL F/ SEAL BODY	PART NO.	568233	568343	568349
	2 Req'd	WT./LBS.	1/8	1/8	1/8
40	SEAL F/ WASHPIPE CONNECTOR I.D (LARGE)	PART NO.	568233	568240	568246
	2 Req'd	WT./LBS.	1/8	1/8	1/8
41	SEAL F/ WASHPIPE CONNECTOR I.D. (SMALL)	PART NO.	568231	568237	568242
	2 Req'd	WT./LBS.	1/8	1/8	1/8
47	O.D SEAL F/FLOATER BODY (LARGE)	PART NO.	568242	568252	568259
		WT./LBS.	1/8	1/8	1/8
52	SEAL F/ FILL PLUG	PART NO.	568010	568010	568108
		WT./LBS.	1/8	1/8	1/8
54	SEAL F/ FLOATER O.D.	PART NO.	568341	568426	568434
		WT./LBS.	1/8	1/8	1/8
55	SEAL F/ FLOATER I.D.	PART NO.	568337	568345	568350
		WT./LBS.	1/8	1/8	1/8
65	SEAL F/ WASHPIPE BODY O.D (LARGE)	PART NO.	568242	568252	568259
		WT./LBS.	1/8	1/8	1/8
66	SEAL F/ WASHPIPE BODY O.D. (SMALL)	PART NO.	568239	568249	568257
	2 Req'd	WT./LBS.	1/8	1/8	1/8
68	SEAL F/ BOTTOM SUB O.D. (LARGE)	PART NO.	568242	568252	568259
		WT./LBS.	1/8	1/8	1/8
69	SEAL F/ BOTTOM SUB O.D. (SMALL)	PART NO.	568239	568249	568257
		WT./LBS.	1/8	1/8	1/8

PowerStroke Hydraulic Drilling Jars Replacement Parts (continued)

Optional Extras

O-RING PACKING SET - STD. TEMP.	PART NO.	156370	156009	156441
	WT./LBS.	3	3	3
COMPLETE PACKING SET - STD TEMP (Includes O-Ring Packing Set)	PART NO.	156359	156010	156442
	WT./LBS.	5	5	5
JAR SERVICE KIT	PART NO.	55403	55403	55403
	WT./LBS.			
PLASTIC THREAD PROTECTOR – PIN	PART NO.	146960	147551	147538
	WT./LBS.	2	2	2
PLASTIC THREAD PROTECTOR – BOX	PART NO.	146959	147552	147540
	WT./LBS.	2	2	2
SAFETY COLLAR	PART NO.	156554	156070	156984
	WT./LBS.	35	50	75
PACKING ASSEMBLY SLEEVE	PART NO.	156535	69421	70635
	WT./LBS.	10	12	14
THREAD PROTECTOR – ACME PIN END	PART NO.	156548	156546	156459
	WT./LBS.	25	35	45
SETTING TOOL F/ SEAL PROT & NON-EXT. RINGS	PART NO.	22709/005	22709/153	22709/180
	WT./LBS.	7	8	10
SETTING TOOL F/ SEAL PROT & NON-EXT. RINGS	PART NO.	22709/009	156487	22729-43
	WT./LBS.	7	8	15
SETTING TOOL F/ SEAL PROT & NON-EXT. RINGS	PART NO.	22709/025	—	—
	WT./LBS.	—	—	—
FILL PLUG ADAPTER (FOR 1/4" NPT 102025 FILL PLUG	PART NO.	102031	102031	102031
	WT./LBS.	—	—	—
FILL PLUG ADAPTER (FOR 1/2" NPT 80900 FILL PLUG	PART NO.	81377	81377	81377
	WT./LBS.	—	—	—
3/8" FILL PLUG WRENCH (FOR 7-3/4" OD JAR)	PART NO.	—	—	38673
	WT./LBS.	—	—	—
SNAP RING PLIERS	PART NO.	77216	77216	77216
	WT./LBS.	—	—	—
FLOATER POSITIONING TOOL	PART NO.	503088	503089	503090
	WT./LBS.	17	28	34
JAR TEST SUB F/MANDREL	PART NO.	156547	156545	156460
	WT./LBS.	27	62	100

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* Denotes Manufacturing and Engineering facilities

Downhole Solutions

Drilling Solutions

Engineering and Project Management Solutions

Lifting and Handling Solutions

Production Solutions

Supply Chain Solutions

Tubular and Corrosion Control Solutions

Well Service and Completion Solutions